Q1

Let A be a square matrix of order 3 such that $\text{adj}(\text{adj}(\text{adj}(A))) = \begin{bmatrix} 16 & 0 & 4 \\ 5 & 4 & 0 \\ 1 & 4 & 3 \end{bmatrix}$ and $\det(A)$ is positive, then which of the following must be correct?

(1) $8 \cdot \text{trace}\left(A^{-1}\right) = 32$

(2) $\det(\text{adj } A) = 4$

(3) $8 \cdot \text{trace}\left(A^{-1}\right) = 23$

(4) $\det(\text{adj } A) = 2$

Q2

Among the 8! permutations of the digits $1, 2, 3, \ldots\ldots\ldots$, consider those arrangements which have the following property. If we take any five consecutive positions, the product of the digits in these positions is divisible by 5. The number of such arrangement is equal to

(1) 7!

(2) 2. (7!)

(3) ${}^{7}\text{C}_{4}$

(4) None of these

Q3

If $\left(x - 2 + \frac{1}{x}\right)^{30} = n_0 x^{30} + n_1 x^{29} + \ldots\ldots + n_{29} x + n_{30} + n_{31} x^{-1} + \ldots\ldots + n_{60} x^{-30}$ and $C = n_0 + n_1 + n_2 + \ldots\ldots + n_{60}$. Find the value of $(a + b)$ if $C - n_{30} = -\binom{a}{b}$.

[Note: $\binom{n}{r}$ denotes ${}^{n}C_{r}$.]

(1) 30

(2) 45

(3) 60

(4) 90

Q4

Let the foot of perpendicular from a point $P(1, 2, -1)$ to the straight line $L : \frac{x}{1} = \frac{y}{0} = \frac{z}{-1}$ be N. Let a line be drawn from P perpendicular to vector $\hat{i} + \hat{j} + 2\hat{k}$ which meets L at point Q. If α is the acute angle between the lines PN and PQ, then $\cos\alpha$ is equal to _____.

(1) $\frac{1}{\sqrt{5}}$

(2) $\frac{\sqrt{3}}{2}$

(3) $\frac{1}{\sqrt{3}}$

(4) $\frac{1}{2\sqrt{3}}$

Q5

Box A contains 2 block and 3 red balls while box B contains 3 black and 4 red balls. Out of these two boxes one is selected at random and the probability of choosing box A is double that of box B. If a red ball is drawn from the selected box, then the probability that it has come from box B is

(1) $\frac{21}{41}$

(2) $\frac{10}{31}$

(3) $\frac{12}{31}$

(4) $\frac{13}{41}$

Q6

Let $I = \int \frac{(e^x-1)(\sin x-\cos x)+x\cos x}{\sin^2 x+(e^x-1-x)^2}dx = \tan^{-1}(f(x)) + C$, where ' C ' is the constant of integration and $\lim_{x\to 0} f(x) = 0$. If $\lim_{x\to 0} \frac{f(x)}{x} = \frac{p}{q}$, where $p, q \in N$ then find the least value of $(p + q)$.

(1) 3

(2) 2

(3) 7

(4) 5

Q7

The area of the region lying above X -axis, and included between the circle $x^2+y^2=2ax$ and the parabola $y^2=ax, a>0$ is

(1) $8\pi a^2$

(2) $a^2\left(\frac{\pi}{4}-\frac{2}{3}\right)$

(3) $\frac{16\pi a^2}{9}$

(4) $\pi\left(\frac{27}{8}+3a^2\right)$

Q8

$g(n)=\int_0^{n^2+n+1} e^{x/2-[x/2]}\left(\frac{x}{2}-\left[\frac{x}{2}\right]\right)d(x-[x]); n\in N$ then $g(n)$

(1) has minimum value as $\frac{1}{4}+\sqrt{e}$

(2) has maximum value as $3-\sqrt{e}$

(3) has minimum value as $\frac{3}{4}-\sqrt{\frac{e}{4}}$

(4) none of these

Q9

A line passing through the point of intersection of $x+y=4$ and $x-y=2$ makes an angle $\tan^{-1}\left(\frac{3}{4}\right)$ with the X -axis. It intersects the parabola $y^2=4(x-3)$ at points (x_1, y_1) and (x_2, y_2), respectively. Then $|x_1-x_2|$ is equal to

(1) $\frac{16}{9}$

(2) $\frac{32}{9}$

(3) $\frac{40}{9}$

(4) $\frac{80}{9}$

Q10

A line L cuts the lines AB, AC and AD of a parallelogram $ABCD$ at points B_1, C_1 and D_1 respectively. If $\overrightarrow{AB_1}=\lambda_1\overrightarrow{AB}, \overrightarrow{AD_1}=\lambda_2\overrightarrow{AD}$ and $\overrightarrow{AC_1}=\lambda_3\overrightarrow{AC}$ then $\frac{1}{\lambda_3}=$

(1) $\frac{1}{\lambda_1}+\frac{1}{\lambda_2}$

(2) $\frac{1}{\lambda_1}-\frac{1}{\lambda_2}$

(3) $-\lambda_1+\lambda_2$

(4) $\lambda_1+\lambda_2$

Q11

For a positive integer m, if $\lim\limits_{x\to\infty}\left(x^3\ \ln\left(\frac{x+1}{x}\right)+\frac{x}{2}-x^2\right)=\frac{1}{m}$. Then the value of m is

(1) 1

(2) 2

(3) 3

(4) 4

Q12

Let $f(x)=x^{2010}+x^{1010}-x^{510}+x^{210}+x^2$. If $f(x)$ is divided by $x^2\left(x^2-1\right)$, then we get remainder as $g(x)$, function of x. If $g(x)$ is defined from R to R, then:

(1) $g(x)$ is injective but not surjective

(2) $g(x)$ is surjective but not injective

(3) $g(x)$ is neither injective nor surjective

(4) $g(x)$ is injective and surjective

Q13

Let three positive numbers $a,\ b,\ c$ are in geometric progression, such that $a,\ b+8,\ c$ are in arithmetic progression and $a,\ b+8,\ c+64$ are in geometric progression. If the arithmetic mean of a, b, c is k, then $\frac{3}{13}k$ is equal to

(1) 4

(2) 8

(3) 6

(4) 2

Q14

The shortest distance between the lines $\bar{r} = (1-t)\hat{\imath} + (t-2)\hat{\jmath} + (3-2t)\hat{k}$ and $\bar{r} = (p+1)\hat{\imath} + (2p-1)\hat{\jmath} + (2p+1)\hat{k}$ is

(1) $\frac{8}{\sqrt{29}}$ units

(2) $\frac{4}{\sqrt{29}}$ units

(3) $\frac{2}{\sqrt{5}}$ units

(4) $\frac{4}{\sqrt{19}}$ units

Q15

Consider the system of equations $2x + P^2y + 6z = 8$, $x + 2\,y + 2\,q\,z = 5$ and $x + y + 3\,z = 4$

(1) Given system has unique solution for $P \neq \pm\sqrt{2}$and $q = \frac{3}{2}$

(2) Given system has no solution for $P = \pm\sqrt{2}$ and $q = \frac{3}{2}$

(3) Given system has infinite solution for $P = \pm\sqrt{2}$ and $q \in R$

(4) None of these

Q16

Consider a differential equation

$\left(x\tan\left(\frac{y}{x}\right) - y\sec^2\left(\frac{y}{x}\right)\right)dx + x\sec^2\left(\frac{y}{x}\right)dy = 0$

with initial condition $y(2) = \frac{\pi}{4}$, then the value of $x\tan\frac{y}{x}$ is

(1) 0.82

(2) 1.82

(3) 2.65

(4) 0.65

Q17

If the quadratic equation $x^2+(2-\tan\theta)x-(1+\tan\theta)=0$ has two integral roots, then sum of all possible values of θ in the interval $(0,2\pi)$ is $k\pi$, then the value of k is equal to

(1) 1

(2) 4

(3) 3

(4) 2

Q18

Let $x_1, x_2, x_3 \ldots x_k$ be k observations and $w_i = ax_i + b$ for $i = 1, 2, 3 \ldots\ldots k$, where a and b are constants. If mean of x_i is 52 and their standard deviation is 12 and mean of w_i is 60 and their standard deviation is 15 , then the value of a and b should be

(1) $a = 1.25,\ b = -5$

(2) $a = -1.25,\ b = 5$

(3) $a = 2.5,\ b = -5$

(4) $a = 2.5,\ b = 5$

Q19

Let $\mathrm{A}(z_1), \mathrm{B}(z_2)$ and $\mathrm{C}(z_3)$ lie on the circle $|z-i|=1$ and satisfy the equation $3z_1 + \mathrm{i} = 2z_2 + 2z_3$. If D is the centre of the circle $|z-i|=1$, then area of quadrilateral ABCD equals :-

(1) $\frac{\sqrt{3}}{4}$

(2) $\frac{\sqrt{5}}{4}$

(3) $\frac{\sqrt{11}}{4}$

(4) $\frac{\sqrt{7}}{4}$

Q20

The equation of the curve obtained by reflecting the ellipse $\frac{(x-4)^2}{16}+\frac{(y-3)^2}{9}=1$ about the line $x-y-2=0$ is $16x^2+9y^2+k_1x-36y+k_2=0$ then sum of prime factors of (k_1+k_2) is

(1) 12

(2) 9

(3) 8

(4) 16

Q21

Last two digits of the number 19^{9^4} is (for example, if last two digits are 06 report 6 and if last two digits are 23 report 23 as answer)

Q22

Let $A = \{x \mid x^3 + x^2 - px + q = 0, p, q, \in R\}$ and $B = \{x \mid x^2 - qx + 2 = 0, q \in R\}$ be the sets. If $n(A \cap B) = 2$ and $x_0 \in (A - B)$, then find the value of $|p - q + x_0|$.

Q23

Consider $\triangle ABC, A(5, -1), B(\alpha, -7), C(-2, \beta)$. Let $(-6, -4)$ is image of orthocentre of $\triangle ABC$ in the point mirror M which is mid-point of the side BC. Also (p, q) is circumcentre of triangle ABC, then the value of $\beta^2 - \alpha^2 + 5\beta - \alpha - 6p + 2q$ is _____.

Q24

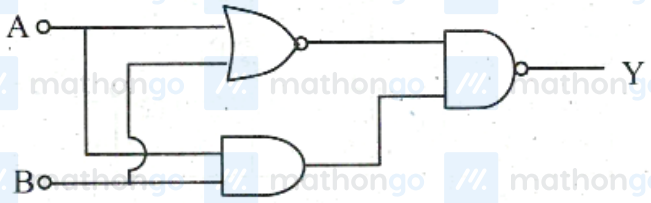
Let $f : R - \{1\} \to R - \{1\}$ be a function satisfying the differential equation $2x(y + x)dx - x^2(dx + dy) = (x + y)^2 dx$ with $f(2) = 2$. If area enclosed by $y = f(x)$ and x-axis from $x = 2$ to $x = 3$ is $(a + \ln b)$ where $a, b \in N$, then find the value of $(a + b)$.

Q25

Let O be the interior point of $\triangle ABC$ such that $2\overrightarrow{OA} + 3\overrightarrow{OB} + 6\overrightarrow{OC} = 0$ where O is origin. If $\frac{\text{Area of } (\triangle ABC)}{\text{Area of } (\triangle AOB)} = \frac{m}{n}$, where m and n are relatively prime, then $(m - n)$ is equal to

Q26

The truth table for the given logic circuit is



A	B	Y
0	0	1
0	1	1
1	0	1
1	1	1

(P)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(Q)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	1

(R)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

(S)

(1) P

(2) Q

(3) S

(4) R

Q27

Assertion: When two soap bubbles having different radii are kept in contact, the common surface at their interface will bulge into a large bubble.

Reason: Pressure inside the smaller bubble is larger.

(1) Assertion is true, reason is true, reason is correct explanation for assertion.

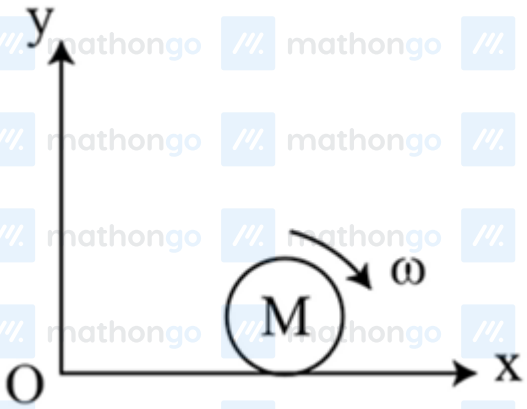
(2) Assertion is true, reason is true, reason is not a correct explanation for assertion.

(3) Assertion is true, reason is false.

(4) Assertion is false, reason is true.

Q28

A disc of mass M and Radius R is rolling with an angular speed ω on the horizontal plane as shown in the figure. The magnitude of angular momentum of the disc about origin is :



(1) $\frac{1}{2}MR^2\omega$

(2) $MR^2\omega$

(3) $\frac{3}{2}MR^2\omega$

(4) $2MR^2\omega$

Q29

The radii of curvature of both the surfaces of a convex lens of focal length ' f ' and focal power ' P ' are equal. One of the surfaces is made plane by grinding. The new focal length and focal power of the lens is

(1) $\frac{2}{3}\mathrm{f}, \frac{2}{3}\mathrm{P}$

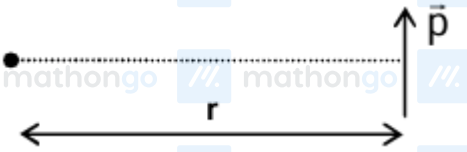
(2) $\sqrt{\frac{2}{\mathrm{f}}}, \sqrt{\frac{\mathrm{P}}{2}}$

(3) $\frac{\mathrm{f}}{2}, 2\mathrm{P}$

(4) $2\mathrm{f}, \frac{\mathrm{P}}{2}$

Q30

An infinitesimal electric dipole of dipole moment $\vec{p}$ is placed at a distance r from a point positive charge Q such that the direction of dipole moment $\vec{p}$ is perpendicular to the line joining the point charge Q and centre of the dipole. If the magnitudes of force and torque exerted by the point charge Q on the dipole are F and τ respectively, then



(1) $\mathrm{F} = \frac{3\mathrm{Qp}}{4\pi\varepsilon_0 \mathrm{r}^3}$

(2) $\mathrm{F} = \frac{\mathrm{Qp}}{2\pi\varepsilon_0 r^3}$

(3) $\tau = \frac{\mathrm{Qp}}{2\pi\varepsilon_0 r^2}$

(4) $\tau = \frac{\mathrm{Qp}}{4\pi\varepsilon_0 \mathrm{r}^2}$

Q31

Consider a glass slab which is silvered at one side and the other side is transparent. Given the refractive index of the glass slab to be 1.5. If a ray of light is incident at an angle of 45° on the transparent side, then the deviation of the ray of light from its initial path, when it comes out of the slab is

(1) 180°

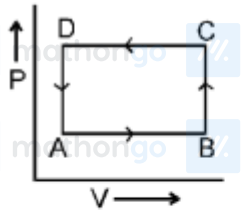
(2) 120°

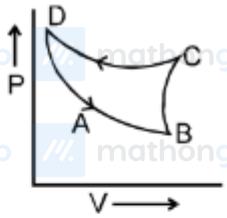
(3) 45°

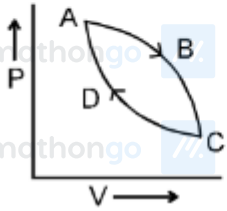
(4) 90°

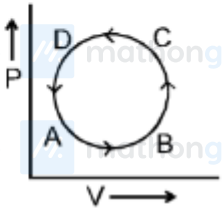
Q32

In the following figures (i) to (iv), variation of volume by change of pressure is shown. A gas is taken along the path ABCDA. The change in internal energy of the gas will be:

(i) 

(ii) 

(iii) 

(iv) 

(1) positive in all cases from (i) to (iv)

(2) positive in cases (i), (ii) and (iii) but zero in case (iv)

(3) negative in cases (i), (ii) and (iii) but zero in case (iv)

(4) zero in all the four cases.

Q33

A straight wire carrying current i is turned into a circular loop. If the magnitude of magnetic moment associated with it in MKS units is M, the length of wire will be

(1) $4\pi iM$

(2) $\sqrt{\frac{4\pi M}{i}}$

(3) $\sqrt{\frac{4\pi i}{M}}$

(4) $\frac{M\pi}{4i}$

Q34

Consider the following statements about interference of light

A. The interference fringes are equally bright and equally spaced

B. At the centre of a bright fringe, the intensity is four times the intensity of the incident wave

C. For constructive interference of two waves, the crest of one wave coincides with trough of another wave.

Which of the above statements are correct?

(1) A and B only

(2) A and C only

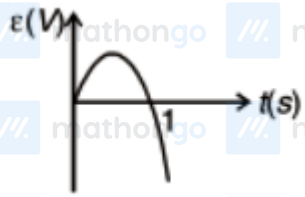
(3) All A, B and C

(4) B and C only

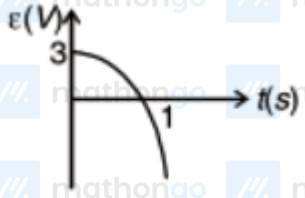
Q35

The magnetic flux linked with a circuit is given by $\phi = t^3 - 3t - 7$. Choose the corrret graph between induced emf $[\varepsilon]$ and time $[t]$.

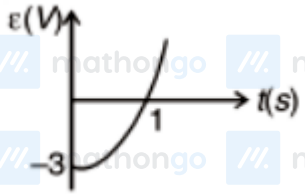
(1)



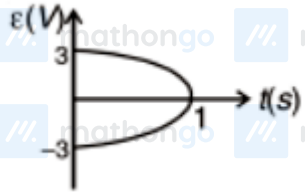
(2)



(3)



(4)



Q36

A ball is projected with a certain speed from a point on the ground which is at a distance of 30 m from a vertical wall. If the angle of projection is 45° with the horizontal, the ball just clears the top of the wall and strikes the ground at a distance of 10 m from the wall on the other side. The height of wall is h. Find 10h.

(Take $g = 10\ \text{ms}^{-2}$)

(1) 125

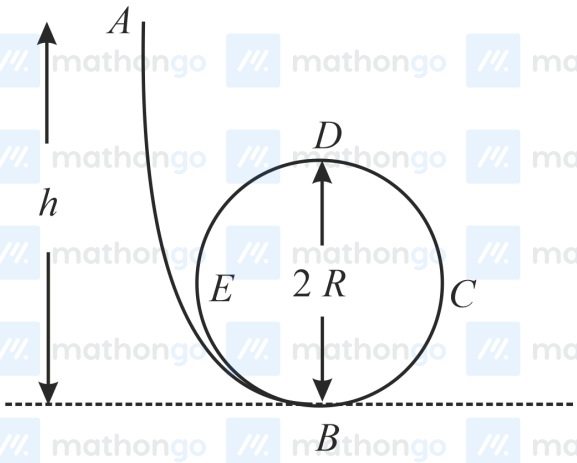
(2) 50

(3) 100

(4) 75

Q37

A frictionless track $ABCDE$ ends in a circular loop of radius R. A body slides down the track from the point A which is at a height $\text{h} = 5$ cm. Maximum value of R for the body to successfully complete the loop is



(1) 5 cm

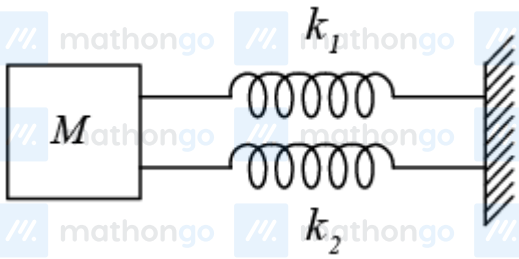
(2) $\frac{15}{4}$ cm

(3) $\frac{10}{3}$ cm

(4) 2 cm

Q38

Two springs with negligible masses and force constants $k_1 = 200\ \mathrm{N/m}$ and $k_2 = 160\ \mathrm{N/m}$ are attached to the block of mass $m = 10$ kg as shown in figure. Initially the block is at rest, at the equilibrium position in which both springs are neither stretched nor compressed. At time $t = 0$, sharp impulse of 50 N-s is given to the block with a hammer along the spring. Then the amplitude of spring will be K metre. Find 6K



(1) 8

(2) 5

(3) 4

(4) 6

Q39

An inductor of reactance 1Ω and a resistor of resistance 3Ω are connected in series to the terminals of 10 V (rms) AC source. The power dissipated in the circuit is

(1) 25

(2) 30

(3) 35

(4) 20

Q40

For the equation $\mathrm{F} = \mathrm{A}^{a}\mathrm{v}^{\mathrm{b}}\mathrm{d}^{\mathrm{c}}$, where F is the force,

A is the area, v is the velocity and d is the density, the values of a, b and c are respectively

(1) 1,2,1

(2) 2,1,1

(3) 1,1,2

(4) 0,1,1

Q41

Ethanol of density $\rho = 700\ \mathrm{kg/m^3}$ flows smoothly through a horizontal pipe that tappers in crosssectional area from $A_1 = 1.2 \times 10^{-3}\ \mathrm{m^2}$ to $A_2 = \frac{A_1}{2}$. The pressure difference between the wide and the narrow sections of pipe is 4200 Pa. What is the volume flow rate of ethanol in multiples of $10^{-4}\ \mathrm{m^3/s}$.

(1) 12

(2) 16

(3) 24

(4) None of these

Q42

Two identical photons of energy $\mathrm{E}(4\mathrm{eV} \leq \mathrm{E} \leq 8\mathrm{eV})$ fall on two different metals whose work functions are in the ratio of $1:2$. The ratio of the kinetic energies of the most energetic electrons coming from each metal is $2:1$. Work function of one of the metal is 4 eV . What is the energy of photon in eV .

(1) 6 eV

(2) 8 eV

(3) 4 eV

(4) 5 eV

Q43

A cylindrical wire has a mass $(0.3 \pm 0.003)g$, radius (0.5 ± 0.005)mm and length (6 ± 0.06)cm. The maximum percentage error in the measurement of its density is

(1) 1

(2) 2

(3) 3

(4) 4

Q44

A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is (R is universal gas constant)

(1) 4 RT

(2) 15 RT

(3) 9 RT

(4) 11 RT

Q45

The position (x) of a body moving along x-axis at time (t) is given by $x = 3t^2$,where x is in metre and t is in second. If mass of body is 2 kg, then find the instantaneous power delivered to body by force acting on it at $t = 4$ s : –

(1) 288 W

(2) 280 W

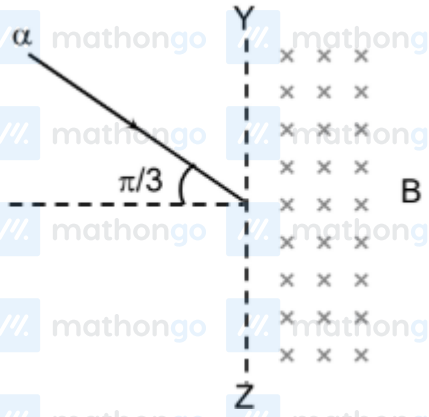
(3) 290 W

(4) 260 W

Q46

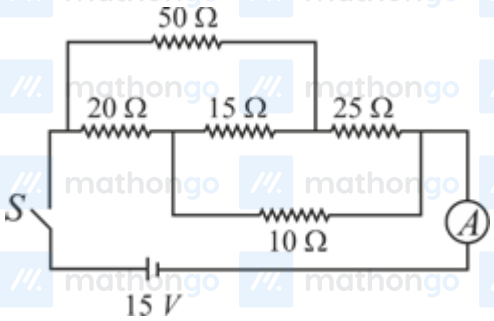
A particle with specific charge α, enters a magnetic field of magnitude B , existing only to the right of the boundary YZ , as shown. The direction of motion of the particle is perpendicular to the direction of B . If the

time spent by the particle in the field is $K \times \frac{\pi}{3\alpha B}$, find the value of ' K '



Q47

When switch S is closed, then the reading of ammeter is A, then value of $10A$ is _____



Q48

If a slab of insulating material. 4×10^{-3} m thick is introduced between the plates of a parallel plate capacitor, the separation between the plates has to be increased by 3.5×10^{-3} m to restore the capacity to original value. The dielectric constant of the material will be

Q49

Two solid balls have different radii but are made of same material. The balls are linked together with a long thin thread and released from a large height. At the terminal velocity, the thread is under tension. The larger ball has a fixed mass, but we have choice of the smaller ball with different masses. At what ratio of larger and smaller mass will this tension be maximum?

Q50

If B_1 is the magnetic field induction at a point on the axis of a circular coil of radius R situated at a distance $R\sqrt{3}$ and B_2 is the magnetic field at the centre of the coil, then the ratio of $\frac{B_1}{B_2}$ is equal to K, find 16K.

Q51

Dissolving 120 g of a compound (mol. wt $= 60$) in 1000 g of water gave a solution of density 1.12 g mL^{-1}. The molarity of solution is

(1) 1.5

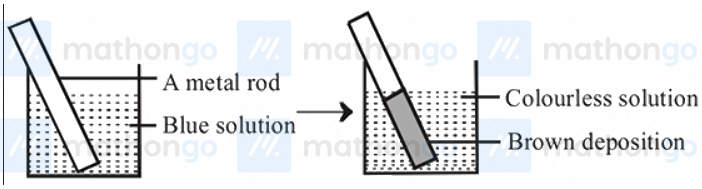
(2) 2

(3) 3

(4) 3.5

Q52

A redox reaction is shown in the diagrams. Identify the reaction.



(1) $Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$

(2) $Cu(s) + 2Ag^{+}(aq) \longrightarrow Cu^{2+}(aq) + 2Ag(s)$

(3) $2Ag(s) + Cu^{2+}(aq) \longrightarrow 2Ag^{+}(aq) + Cu(s)$

(4) $Cu(s) + Zn^{2+}(aq) \longrightarrow Cu^{2+}(aq) + Zn(s)$

Q53

Match List - I with List - II.

List-I (complexes)		List-II (magnetic moment)	
(a)	$[Fe(CN)_6]^{3-}$	(i)	5.92 BM

(b)	$\left[Fe\left(H_2O\right)_6\right]^{3+}$	(ii)	0 BM
(c)	$\left[Fe\left(CN\right)_6\right]^{4-}$	(iii)	4.90 BM
(d)	$\left[Fe\left(H_2O\right)_6\right]^{2+}$	(iv)	1.73 BM

Choose the correct answer from the options given below.

(1) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

(2) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

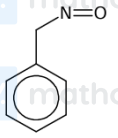
(3) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

(4) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Q54

Consider the following compounds:

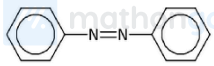
(I) 

(II) 

(III) 

(IV) 

(V) 

(VI) 

Let, the compound(s) which cannot be Kjeldahlised be ' x ' the compound(s) which gives blue colour in Lassaigne's test of nitrogen be y and the compound(s) which gives red colour in Lassaigne's test of nitrogen be z.

So, the value of $\left(\frac{x+y}{z}\right)$ will be:

(1) 4

(2) 5

(3) 9

(4) 10

Q55

Two reactions, A $\rightarrow$ Products and B $\rightarrow$ Products, have rate constants K_a and K_b at temperature T and activation energies E_a and E_b respectively. If $K_a > K_b$ and $E_a < E_b$ and assuming that A for both the reactions is same then :

(1) At higher temperatures K_a will be lesser than K_b

(2) At lower temperature K_a and K_b will differ more and $K_a > K_b$

(3) As temperature rises K_a and K_b will be close to each other in magnitude

(4) None of these

Q56

What are X and Y respectively in the following reaction?

Z-product $\xleftarrow{Y}$ 2-butyne $\xrightarrow{X}$ E-product

(1) Na/NH_3 (liq.) and $Pd/BaSO_4 + H_2$

(2) $Ni/140^\circ C$ and $Pd/BaSO_4 + H_2$

(3) $Ni/140^\circ C$ and Na/NH_3 (liq.)

(4) $Pd/BaSO_4 + H_2$ and Na/NH_3 (liq.)

Q57

Which of the following is a disproportionation reaction?

(1) $Cl_2(g) + 2OH^-(aq) \rightarrow ClO^-(aq) + Cl^-(aq) + H_2O(l)$

(2) $Cl_2(g) + 2I^-(aq) \rightarrow 2Cl^-(aq) + I_2(s)$

(3) $2\ Fe(s) + 3\ H_2O(l) \xrightarrow{\Delta} Fe_2O_3(s) + 3\ H_2(g)$

(4) $2H_2O(l) + 2F_2(g) \rightarrow 4HF(aq) + O_2(g)$

Q58

Zirconium phosphate $[Zr_3(PO_4)_4]$ dissociates into three zirconium cations of charge +4 and four phosphate anions of charge -3. If molar solubility of zirconium phosphate is denoted by S and its solubility product by

K_{sp} then which of the following relationship between S and K_{sp} is correct ?

(1) $S = \{K_{sp}/6912\}^7$

(2) $S = \{K_{sp}/144\}^{1/7}$

(3) $S = \left\{K_{sp}/(6912)^{1/7}\right\}$

(4) $S = (K_{sp}/6912)^{1/7}$

Q59

Select the set having incorrect statements given here.

(i) Manganese exhibits +7 oxidation state

(ii) Zinc forms coloured ions

(iii) $\left[CoF_6\right]^{3-}$ is diamagnetic

(iv) Sc forms +4 oxidation state

(v) Zn exhibits only +2 oxidation state

(1) (i), (ii) and (iii)

(2) (ii), (iii) and (iv)

(3) (i), (iii) and (iv)

(4) (i), (iii) and (v)

Q60

An ideal gas is expanded from $(p_1,\ V_1,\ T_1)$ to $(p_2,\ V_2,\ T_2)$ under different conditions. The incorrect statement among the following is?

(1) The word done by the gas is less when it is expanded reversibly from V_1 to V_2 under adiabatic conditions as compared to that when expanded reversibly from V_1 to V_2 under isothermal conditions

(2) The change in internal energy of the gas is (i) zero, if it is expanded reversibly with $T_1 = T_2$ and (ii) positive, if it is expanded reversibly under adiabatic conditions with $T_1 \neq T_2$

(3) If the expansion is carried out freely, it is simultaneously both isothermal as well as adiabatic

(4) The work done on the gas is maximum when it is compressed irreversibly from $(p_2,\ V_2)$ to $(p_1,\ V_1)$ against constant pressure p_1

Q61

A tetrapeptide has $-COOH$ group on alanine. This produces glycine (Gly), valine (Val), phenyl alanine (Phe) and alanine (Ala), on complete hydrolysis. For this tetrapeptide, the number of possible sequences (primary structures) with $-NH_2$ group attached to a chiral center is

(1) 2

(2) 3

(3) 4

(4) 5

Q62

If photons of energy 12.75 eV are passing through hydrogen gas in ground state then no. of lines in emission spectrum will be

(1) 6

(2) 4

(3) 3

(4) 2

Q63

Assertion : More is the electron affinity greater is the reducing character.

Reason : Reducing character depends on oxidation potential.

(1) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(2) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(3) If assertion is true but reason is false.

(4) If assertion is false but reason is true.

Q64

The tests performed on compound X and their inferences are

Test Inference

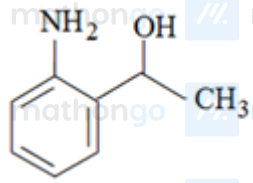
(1) 2,4- DNP test coloured precipitate

(2) iodoform test yellow precipitate

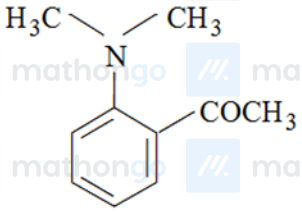
(3) Azo dye test no dye formation

Compound 'X' is

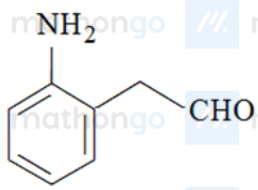
(1)

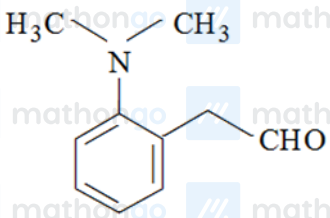


(2)



(3)





(4)

Q65

How many isomeric dienes with a six membered ring are possible of the compound with the molecular formula C_7H_{10} ?

(1) 6

(2) 3

(3) 5

(4) 7

Q66

The reaction condition leading to the best yield of C_2H_5Cl are

(1) $C_2H_6\ (\text{excess}) + Cl_2 \xrightarrow{\text{UV light}}$

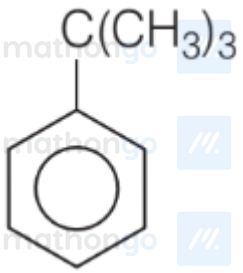
(2) $C_2H_6 + Cl_2\ (\text{excess}) \xrightarrow[\text{room temp.}]{\text{dark}}$

(3) $C_2H_6 + Cl_2 \xrightarrow{\text{UV light}}$

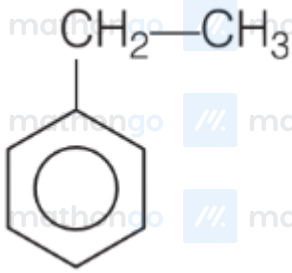
(4) $C_2H_6 + Cl_2\ (\text{excess}) \xrightarrow{\text{UV light}}$

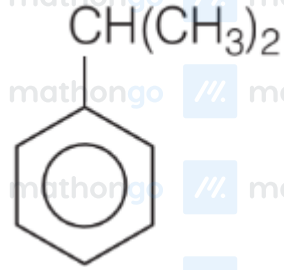
Q67

Identify the compound, which has maximum number of no bond resonance structures.



(1)

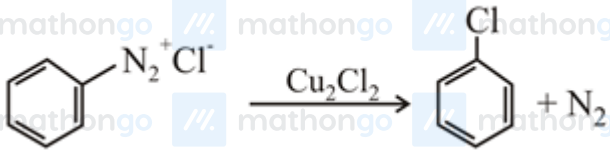
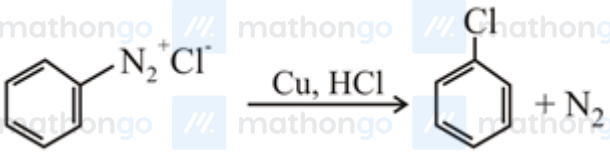
(2) 

(3) 

(4) 

Q68

Match List-I with List-II.

List-I		List-II	
(a)		(i)	Wurtz reaction
(b)		(ii)	Sandmeyer reaction
(c)	$2\,CH_3\,CH_2\,Cl + 2Na \xrightarrow{\text{Ether}} C_2H_5 - C_2H_5 + 2\,NaCl$	(iii)	Fittig reaction
(d)	$2C_6H_5Cl + 2Na \xrightarrow{\text{Ether}} C_6H_5 - C_6H_5 + 2\,NaCl$	(iv)	Gatterman reaction

Choose the correct answer from the options given below:

(1) (a)→(iii), (b)→(iv), (c)→(i), (d)→(ii)

(2) (a)→(ii), (b)→(i), (c)→(iv), (d)→(iii)

(3) (a)→(iii), (b)→(i), (c)→(iv), (d)→(ii)

(4) (a)→(ii), (b)→(iv), (c)→(i), (d)→(iii)

Q69

Which of the following molecules does not exhibit dipole moment?

(i) CCl_4

(ii) CO_2

(iii) NH_3

(iv) $CHCl_3$

(v) H_2O

(vi) $CH_3 - O - CH_3$

(1) (ii), (v), (iv)

(2) (i), (iii), (vi)

(3) (i), (ii)

(4) (iii), (iv), (vi)

Q70

Which of the following is not correctly matched?

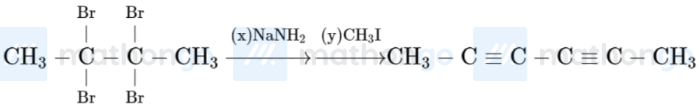
(1) Acidic oxides P_2O_5, NO_2, Cl_2O_7

(2) Basic oxides Na_2O, CaO, MgO

(3) Neutral oxides CO_2, CO, BeO

(4) Amphoteric oxides ZnO, SnO, Al_2O_3

Q71



x and y mole consumed. Find the value of $x + y$?

Q72

A 0.50 g mixture of Cu_2O and CuO contains 0.425 g of Cu. Mass of CuO (in g) in mixture is K, find value of 10 K in the mixture? $(Cu = 63.5\ u,\ O = 16\ u)$

(Mark answer to nearest integer)

Q73

The bond dissociation energies for Cl_2, I_2 and ICl are 242.3, 151 and $211.3 kJ/mol$ respectively. The enthalpy of sublimation of iodine is $62.8\ kJ/mol$. What is the standard enthalpy of formation of ICl (g) ? (roundoff answer to nearest integer in KJ/mol)

Q74

Among the elements of lanthanoid series $({}_{58}Ce_{-71}Lu)$, the total number of elements which have odd number of electrons in f-orbitals in their ground state configuration.

Q75

Find the total number of possible isomers for the complex compound

$\left[Cu^{II}(NH_3)_4\right]\left[Pt^{II}Cl_4\right]$

Answer Key

Q1 (2, 3)	**Q2** (2)	**Q3** (4)	**Q4** (3)
Q5 (2)	**Q6** (1)	**Q7** (2)	**Q8** (4)
Q9 (2)	**Q10** (1)	**Q11** (3)	**Q12** (3)
Q13 (1)	**Q14** (3)	**Q15** (3)	**Q16** (1)
Q17 (2)	**Q18** (1)	**Q19** (4)	**Q20** (4)
Q21 (19)	**Q22** (3)	**Q23** (10)	**Q24** (3)
Q25 (5)	**Q26** (1)	**Q27** (1)	**Q28** (3)
Q29 (4)	**Q30** (4)	**Q31** (4)	**Q32** (4)
Q33 (2)	**Q34** (1)	**Q35** (2)	**Q36** (4)
Q37 (4)	**Q38** (2)	**Q39** (2)	**Q40** (1)
Q41 (3)	**Q42** (1)	**Q43** (4)	**Q44** (4)
Q45 (1)	**Q46** (5)	**Q47** (7)	**Q48** (8)
Q49 (8)	**Q50** (2)	**Q51** (2)	**Q52** (1)
Q53 (4)	**Q54** (3)	**Q55** (3)	**Q56** (1)
Q57 (1)	**Q58** (4)	**Q59** (2)	**Q60** (2)
Q61 (3)	**Q62** (1)	**Q63** (4)	**Q64** (2)
Q65 (4)	**Q66** (1)	**Q67** (4)	**Q68** (4)

Q69 (3)

Q70 (3)

Q71 (8)

Q72 (2)

Q73 (17)

Q74 (8)

Q75 (4)

Q1

$|\operatorname{adj}(\operatorname{adj}(\operatorname{adj} A))| = |A|^8 = 256 \Rightarrow |A| = 2$

$\operatorname{adj}(\operatorname{adj}(\operatorname{adj}(A))) = |\operatorname{adj} A|(\operatorname{adj} A) = 4(\operatorname{adj} A) = \begin{bmatrix} 16 & 0 & 4 \\ 5 & 4 & 0 \\ 1 & 4 & 3 \end{bmatrix}$

$\Rightarrow \operatorname{adj}(A) = \begin{bmatrix} 4 & 0 & 1 \\ \frac{5}{4} & 1 & 0 \\ \frac{1}{4} & 1 & \frac{3}{4} \end{bmatrix} \Rightarrow A^{-1} = \begin{bmatrix} 2 & 0 & \frac{1}{2} \\ \frac{5}{8} & \frac{1}{2} & 0 \\ \frac{1}{8} & \frac{1}{2} & \frac{3}{8} \end{bmatrix}$

Q2

Let the arrangement be $x_1x_2x_3x_4x_5x_6x_7x_8$

Clearly, 5 should occupy the positionx_4 or x_5 . Thus required number of ways are

$= {}^2C_1 \times 7!$

$= 2(7!)$

Q3

$\left(x - 2 + \frac{1}{x}\right)^{30} = n_0x^{30} + n_1x^{29} + \ldots\ldots + n_{29}x + n_{30} + n_{31}x^{-1} + \ldots\ldots + n_{60}x^{-30}$

$(x-1)^{60} = n_0x^{60} + n_1x^{59} + \ldots\ldots + n_{29}x^{31} + n_{30}x^{30} + n_{31}x^{29} + \ldots\ldots + n_{60}$

$\therefore n_0 = {}^{60}C_0, n_1 = -{}^{60}C_1, n_2 = {}^{60}C_2, \ldots\ldots n_{30} = {}^{60}C_{30} \ldots\ldots n_{60} = {}^{60}C_{60}$

$\therefore C = n_0 + n_1 + n_2 + \ldots\ldots + n_{60} = 0$

Hence, $C - n_{30} = -\begin{pmatrix} a \\ b \end{pmatrix}$

$\Rightarrow \quad 0 - 1 \cdot \left({}^{60}C_{30}\right)$

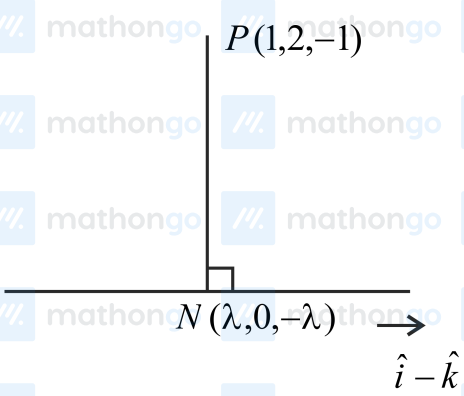
$\therefore \quad a = 60, b = 30$

Hence, $a + b = 90$.

Q4

Assume, $\frac{x}{1} = \frac{y}{0} = \frac{z}{-1} = \lambda$

So, coordinate of any point on the line is $(\lambda, 0, -\lambda)$.

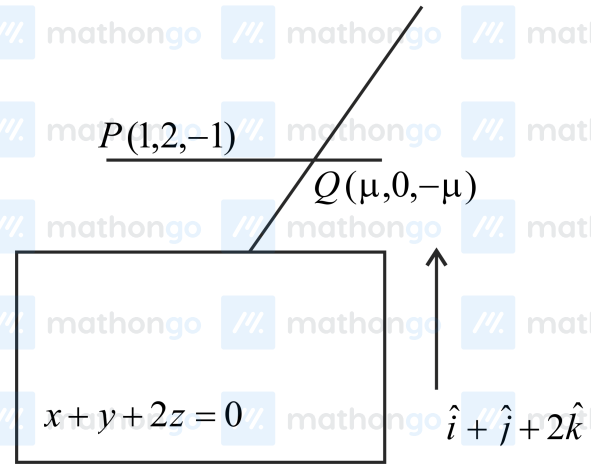


As N is the foot of the perpendicular,

$\overrightarrow{PN} \cdot \left(\hat{i} - \hat{k}\right) = 0 \Rightarrow \lambda = 1$

Hence, the coordinate of $N = (1, 0, -1)$

Now,



Assume, the coordinate of $Q = (\mu, 0, -\mu)$

So, $\overrightarrow{PQ} \cdot \left(\hat{i} + \hat{j} + 2\hat{k}\right) = 0$

$\Rightarrow \mu = -1$

So, the coordinate of $Q = (-1, 0, 1)$

Hence, $\overrightarrow{PN} = 2\hat{j}$ and $\overrightarrow{PQ} = 2\hat{i} + 2\hat{j} - 2\hat{k}$

$$\Rightarrow \cos\alpha = \frac{\overrightarrow{PN}\cdot\overrightarrow{PQ}}{\left|\left(\overrightarrow{PN}\right)\left(\overrightarrow{PQ}\right)\right|} = \frac{(2j)\cdot(2i+2j-2k)}{\left(\sqrt{2^2}\right)\left(\sqrt{2^2+2^2+2^2}\right)} = \frac{1}{\sqrt{3}}$$

Q5

Let the events be defined as:

- A : Selection of box A

- B : Selection of box B

- R : Drawing a red ball

Given Conditions:

$$P(B) = p, \quad P(A) = 2P(B) = 2p$$

Probabilities of drawing a red ball from each box:

$$P(R \mid A) = \frac{{}^3C_1}{{}^5C_1} = \frac{3}{5}$$

$$P(R \mid B) = \frac{{}^4C_1}{{}^7C_1} = \frac{4}{7}$$

Using Bayes' Theorem:

$$P(B \mid R) = \frac{P(B)\cdot P(R|B)}{P(A)\cdot P(R|A)+P(B)\cdot P(R|B)}$$

Substitute the values:

$$= \frac{p \cdot \frac{4}{7}}{2p \cdot \frac{3}{5} + p \cdot \frac{4}{7}}$$

$$= \frac{\frac{4p}{7}}{\frac{6p}{5} + \frac{4p}{7}}$$

Simplifying the denominator:

$$= \frac{4p/7}{(42p + 20p)/35}$$

$$= \frac{4p/7}{62p/35}$$

Simplify the fraction:

$$= \frac{4}{7} \times \frac{35}{62}$$

$$= \frac{10}{31}$$

Q6

$$I = \int \frac{(e^x - 1)(\sin x - \cos x) + x \cos x}{\sin^2 x \left(1 + \left(\frac{e^x - 1 - x}{\sin x}\right)^2\right)} dx$$

$$\text{Put, } \frac{e^x - 1 - x}{\sin x} = t \Rightarrow \frac{(\sin x)(e^x - 1) - (e^x - 1 - x)\cos x}{\sin^2 x} dx = dt$$

$$\Rightarrow \frac{(e^x - 1)(\sin x - \cos x) + x \cos x}{\sin^2 x} dx = dt$$

$$\therefore \quad I = \int \frac{dt}{1 + t^2} = \tan^{-1}\left(\frac{e^x - 1 - x}{\sin x}\right) + C$$

$$\therefore \quad f(x) = \frac{e^x - 1 - x}{\sin x}$$

$$\lim_{x \to 0} \frac{f(x)}{x} = \lim_{x \to 0} \frac{e^x - 1 - x}{x\left(\frac{\sin x}{x}\right)x} = \frac{1}{2} \equiv \frac{p}{q}$$

$$\therefore (p + q)|_{\text{least}} = 3$$

Q7

Given, equation of circle $x^2 + y^2 = 2ax$

$\Rightarrow (x-a)^2 + y^2 = a^2$

and equation of parabola is $y^2 = ax, a > 0$

Intersection points of circle and parabola

$\Rightarrow \quad x^2 + ax = 2ax$

$\Rightarrow \qquad x^2 = ax$

$\Rightarrow \quad x^2 - ax = 0$

$\Rightarrow \quad x(x-a) = 0$

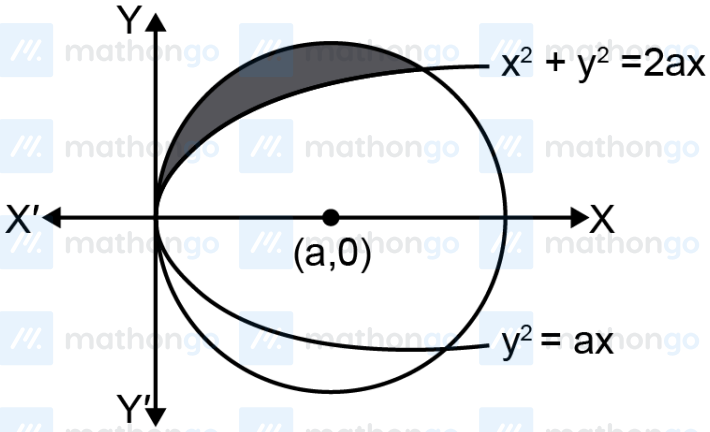
$\Rightarrow \quad x = 0, a$

Intersecting points are $(0,0)$ and (a,a)

$\therefore$ Required area $= \frac{\pi a^2}{4} - \int_0^a \sqrt{ax}\,dx$

$= \frac{\pi a^2}{4} - \sqrt{a}\left(\frac{x^{3/2}}{3/2}\right)_0^a$

$= \frac{\pi a^2}{4} - \frac{2a^2}{3} = a^2\left(\frac{\pi}{4} - \frac{2}{3}\right)$



Q8

$g(n)=\int_0^{n^2+n+1} e^{\{x/2\}}\left\{\frac{x}{2}\right\} d\{x\}$

$=\left(n^2+n+1\right) \int_0^1 e^{(x/2)}\left\{\frac{x}{2}\right\} dx$

$=\left(n^2+n+1\right) \int_0^1 e^{x/2}\left(\frac{x}{2}\right) dx$

$=n^2+n+1\left[4-2e^{1/2}\right]$

So, minimum value is $12-6\sqrt{\mathrm{e}}$

Q9

Given equations are

$x+y=4 \ldots (i)$

and $\quad x-y=2$ ...(ii)

From Eqs. (i) and (ii), we get

$x=3$ and $y=1$

The line through this point making an angle $\tan^{-1}\frac{3}{4}$ with the X -axis is

$(y-1)=\frac{3}{4}(x-3)\left[\because m=\frac{3}{4}\right]$

$\Rightarrow y=\frac{3x}{4}-\frac{5}{4}=\frac{3x-5}{4}$

Since, this line intersects the parabola

$y^2=4(x-3)$ at points (x_1,y_1) and (x_2,y_2), respectively.

$\therefore$ Putting $y=\frac{3x-5}{4}$ in equation of parabola, we get

$\left(\frac{3x-5}{4}\right)^2=4(x-3)$

$\Rightarrow 9x^2-94x+217=0$

$\Rightarrow x_1+x_2=\frac{94}{9}$ and $x_1x_2=\frac{217}{9}$

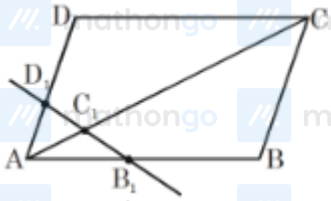
$$\therefore |x_1-x_2|=\sqrt{(x_1+x_2)^2-4x_1x_2}$$
$$=\sqrt{\left(\frac{94}{9}\right)^2-4\times\frac{217}{9}}$$
$$=\frac{32}{9}$$

Q10

$\overrightarrow{AB}=\lambda_1\overrightarrow{AB}$

$\overrightarrow{AD_1}=\lambda_2\overrightarrow{AD}$

$\overrightarrow{AC_1}=\lambda_3\overrightarrow{AC}$



As, $ABCD$ is a parallelogram

$\Rightarrow \overrightarrow{AB}+\overrightarrow{BC}=\overrightarrow{AC}$

$\Rightarrow \overrightarrow{AB}+\overrightarrow{AD}=\overrightarrow{AC}$

$\Rightarrow \frac{\overrightarrow{AB_1}}{\lambda_1}+\frac{\overrightarrow{AD_1}}{\lambda_2}=\frac{\overrightarrow{AC_1}}{\lambda_3}$

$\Rightarrow \frac{\overrightarrow{AB_1}}{\lambda_1}+\frac{1}{\lambda_2}\overrightarrow{AD_1}+\left(\frac{-1}{\lambda_3}\right)\overrightarrow{AC_1}=\overrightarrow{0}$

Here points B, C and D are collinear

$\Rightarrow \frac{1}{\lambda_1}+\frac{1}{\lambda_2}+\frac{-1}{\lambda_3}=0 \Rightarrow \frac{1}{\lambda_3}=\frac{1}{\lambda_1}+\frac{1}{\lambda_2}$

Q11

$\lim\limits_{x\to\infty} x^3\ln\left(1+\frac{1}{x}\right)+\frac{x}{2}-x^2$

$x=\frac{1}{t}$

$\lim\limits_{t\to0}\left(\frac{\ln(1+t)}{t^3}+\frac{1}{2t}-\frac{1}{t^2}\right)=\lim\limits_{t\to0}\frac{2\ln(1+t)+t^2-2t}{2t^3}$

$=\lim\limits_{t\to0}\frac{2\left(t-\frac{t^2}{2}+\frac{t^3}{3}-\frac{t^4}{4}+\ldots\right)+t^2-2t}{2t^3}$

$=\lim\limits_{t\to0}\left(\frac{1}{3}-\frac{t}{4}+\frac{t^2}{5}\ldots..\right)=\frac{1}{3}=\frac{1}{m}\Rightarrow m=3.$

Q12

Let remainder $g(x)$ be ax^3+bx^2+cx+d

$\because$ $f(x)=x^2\left(x^2-1\right)Q(x)+ax^3+bx^2+cx+d$, where $Q(x)$ is quotient

$\therefore$ RHS should have common factor x^2.

$\therefore$ $c=d=0$

$f(1)=a+b=3$

and $f(-1)=-a+b=3$

$\therefore$ $b=3$ and $a=0$

$\therefore$ $g(x)=3x^2$ which is many one into function.

$\therefore$ $g(x)=0 \quad \Rightarrow \quad x=0$ lies between roots of $x^2-2(a+1)x+a(a-1)=0$

$\therefore$ $a(a-1)<0 \quad \Rightarrow \quad 0<a<1$

Q13

Here, $b^2=ac, 2(b+8)=a+c,$

$(b+8)^2=a(c+64)$

$\Rightarrow b^2+64+16b=ac+64a$

$\Rightarrow b+4=4a \Rightarrow b=4a-4$

$2(b+8)=a+c \Rightarrow 2(4a+4)=a+c$

$\Rightarrow c=7a+8$

$b^2=ac \Rightarrow (4a-4)^2=a(7a+8)$

$\Rightarrow 16a^2+16-32a=7a^2+8a$

$\Rightarrow 9a^2-40a+16=0$

$\Rightarrow (9a-4)(a-4)=0 \Rightarrow a=\frac{4}{9}, 4$

But for $a=\frac{4}{9} \Rightarrow b<0$

So, $a = 4 \Rightarrow b = 12$ and $c = 36$

$\Rightarrow k = \frac{a+b+c}{3} = \frac{52}{3}$

$\Rightarrow \frac{3k}{13} = \frac{3}{13} \times \frac{52}{3} = 4$

Q14

$\ell_1 : \bar{r} = (1-t)\hat{i} + (t-2)\hat{j} + (3-2t)\hat{k}$

$= (\hat{i} - 2\hat{j} + 3\hat{k}) + t(-\hat{i} + \hat{j} - 2\hat{k})$

$\ell_2 : \bar{r} = (\hat{i} - \hat{j} + \hat{k}) + p(\hat{i} + 2\hat{j} + 2\hat{k})$

Here $\bar{a}_2 - \bar{a}_1 = (\hat{i} - \hat{j} + \hat{k}) - (\hat{i} - 2\hat{j} + 3\hat{k}) = \hat{j} - 2\hat{k}$

$$\bar{b}_1 \times \bar{b}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & 1 & -2 \\ 1 & 2 & 2 \end{vmatrix} = \hat{i}(2+4) - \hat{j}(0) - 3\hat{k} = 6\hat{i} - 3\hat{k}$$

$\therefore |\bar{b}_1 \times \bar{b}_2| = \sqrt{36+9} = 3\sqrt{5}$

$$\text{shortest distance} = \left| \frac{(\bar{b}_1 \times \bar{b}_2) \cdot (\bar{a}_2 - \bar{a}_1)}{(\bar{b}_1 \times \bar{b}_2)} \right| = \left| \frac{(6\hat{i} - 3\hat{k}) \cdot (\hat{j} - 2\hat{k})}{3\sqrt{5}} \right| = \frac{6}{3\sqrt{5}} = \frac{2}{\sqrt{5}}$$

Q15

$$D = \begin{vmatrix} 2 & p^2 & 6 \\ 1 & 2 & 2q \\ 1 & 1 & 3 \end{vmatrix} = (P^2 - 2)\left(2q - 3\right)$$

$D_2 = 0$

$D_1 = (P^2 - 2)(8q - 15), \; D_3 = (P^2 - 2)$

Q16

$x \tan \frac{y}{x} - y \sec^2\left(\frac{y}{x}\right) + x \sec^2\left(\frac{y}{x}\right)\frac{dy}{dx} = 0$

$\Rightarrow \frac{dy}{dx} = \frac{y}{x} - \frac{1}{2}\sin\left(\frac{2y}{x}\right)$

Put $y = vx$

$\frac{dy}{dx} = v + x\frac{dv}{dx}$

$v + x\frac{dv}{dx} = v - \frac{1}{2}\sin 2v$

$2 \operatorname{cosec} 2v dv = -\frac{dx}{x}$

$\ln(\tan v) = -\ln x + \ln C$

$\Rightarrow x \tan \frac{y}{x} = C$

$x = 2, y = \frac{\pi}{4}$

$x \tan \frac{y}{x} = C$

$2 \tan \frac{\pi}{8} = C$

$C = 2(\sqrt{2} - 1) = 2(1 \cdot 414 - 1) = 0.828$

$\Rightarrow 0.82$

Q17

$x^2 + (2 - \tan\theta)x - (1 + \tan\theta) = 0$

$\alpha + \beta = \tan\theta - 2....(i)$

$\alpha\beta = -\tan\theta - 1$

From equation $(1) + (2)$

$\alpha + \beta + \alpha\beta = -3$

$(\alpha + 1)(\beta + 1) = -2$

Hence either $\alpha + 1 = -2$ and $\beta + 1 = 1$

then $\alpha = -3, \beta = 0$

or $\alpha + 1 = -1$ and $\beta + 1 = 2$

$\alpha = -2$ and $\beta = 1$

If $\alpha = -3, \beta = 0$ then $\tan\theta = -1$

$\Rightarrow \alpha = \frac{3\pi}{4}, \frac{7\pi}{4}$

If $\alpha = -2, \beta = 1$ then $\tan\theta = 1$

$\Rightarrow \theta = \frac{\pi}{4}, \frac{5\pi}{4}$

Sum $= \frac{3\pi}{4} + \frac{7\pi}{4} + \frac{\pi}{4} + \frac{5\pi}{4} = 4\pi = 4$

Q18

$w_i = ax_i + b$

$\Rightarrow \bar{w} = a\bar{x} + b$

$\Rightarrow 60 = a(52) + b \ldots$

S. D of $w = |a|$ (S. D of x_i)

$15 = |a|12$

$\Rightarrow a = \pm 1.25\ldots$

From (i) and (ii), we get,

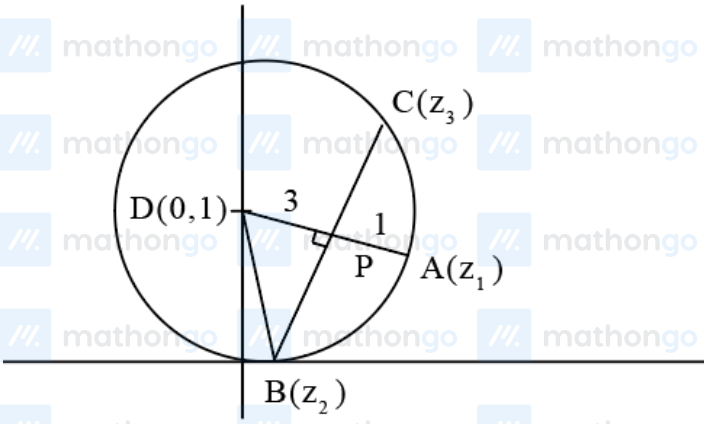
If $a = 1.25 \Rightarrow 60 = 65 + b \Rightarrow b = -5$

If $a = -1.25 \Rightarrow 60 = -65 + b \Rightarrow b = 125$

Q19

$\frac{3z_1 + i}{4} = \frac{2z_2 + 2z_3}{4}$

$P =$ point of intersection of AD&BC



$AD = 1 \Rightarrow DP = \frac{3}{4}$

$BP = \sqrt{1 - \frac{9}{16}} = \frac{\sqrt{7}}{4} \Rightarrow BC = \frac{\sqrt{7}}{2}$

area of Quad. $ABCD = \frac{1}{2} \cdot AD \times BC$

$= \frac{1}{2} \times 1 \times \frac{\sqrt{7}}{2} = \frac{\sqrt{7}}{4}$

Q20

Let $h = 4 + 4\cos\phi, \mathrm{k} = 3 + 3\sin\phi$

Reflection about line $x - y - z = 0$ & taken 10 cm of (h, k)

We get,

$16x^2 + 9y^2 - 160x - 36y + 292 = 0$

$k_1 + k_2 = 132 = 2^2 \cdot 3 \cdot 11$

sum of prime factors $= 2 + 3 + 11 = 16$

Q21

$19^{9^4} = 19^{6561}$

First we will find the second last digit.

To find second last digit, we will multiply tens digit of the number (1 here) with the last digit of exponent (1 here)

Second last digit $= 1 \times 1 = 1$

To find last digit we will Analyze power of 9 (last digit of number)

$9^1 \to 9$

$9^2 \to 81$

$9^3 \to 729$

If power is odd then last digit is 9 otherwise it is 1

We have 6561 in power (odd)

$\therefore$ last digit $= 9$

Hence, last 2 digit of $19^{9^4} = 19$

Q22

$(x - x_0)\left(x^2 - qx + 2\right) = x^3 + x^2 - px + q$

$\Rightarrow -x_0 - q = 1, 2 + qx_0 = -p, -2x_0 = q$

$\Rightarrow x_0 = 1, q = -2, p = 0$

$\therefore |p - q + x_0| = 3$

Q23

Othrocentre is $(\alpha + 4, \beta - 3)$

Use O, G, C collinear and G divide O and C in $2:1$, to get p and q

$p = \frac{-1}{2}; \quad q = \frac{-5}{2}$

$m_1 m_2 = -1$

$\frac{\beta - 2}{\alpha - 1}\left(\frac{\beta + 7}{\alpha + 2}\right) = 1$

$(\beta - 2)(\beta + 7) = (\alpha - 1)(\alpha + 2)$

$\beta^2 + 5\beta - 14 = \alpha^2 + \alpha - 2$

$\beta^2 - \alpha^2 + 5\beta - \alpha = 12$

$6p - 2q = 2$

Q24

$x^2 dy + y^2 dx = 0$

$\Rightarrow \quad \frac{dy}{y^2} + \frac{dx}{x^2} = 0 \Rightarrow \frac{-1}{y} - \frac{1}{x} = C$

$(2, 2) \Rightarrow C = 1$

$\therefore \quad \frac{1}{y} + \frac{1}{x} = 1 \Rightarrow y = \frac{x}{x - 1}$

Required area $= \int_2^3 \frac{x}{x-1} dx = \int_2^3 \left(1 + \frac{1}{x-1}\right) dx \Rightarrow (x + \ln(x-1))_2^3 = 1 + \ln 2 \equiv a + \ln b$

Hence, $a + b = 3$

Q25

Area of $\triangle ABC = \frac{1}{2}|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}|$

Now given $2\vec{a} + 3\vec{b} + 6\vec{c} = 0$

Cross with $\vec{a}, 3\vec{a} \times \vec{b} + 6\vec{a} \times \vec{c} = 0$

or $\vec{a} \times \vec{b} = 2(\vec{c} \times \vec{a}) \ldots\ldots (i)$

Again cross with $\vec{b}$

$2\vec{a} \times \vec{b} + 6\vec{c} \times \vec{b} = 0$

or $\vec{a} \times \vec{b} = 3(\vec{b} \times \vec{c})$

Area of $\Delta OAB = \frac{1}{2}|\vec{a} \times \vec{b}|$

$\frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle AOB} = \frac{\frac{1}{2}|\vec{a} \times \vec{b}|\left(1 + \frac{1}{2} + \frac{1}{3}\right)}{\frac{1}{2}|\vec{a} \times \vec{b}|} = \frac{11}{6}$

So $m = 11, n = 6 \Rightarrow (m - n) = 5$

Q26

From the logic circuit,

$$Y = \overline{(\overline{A + B}) \cdot (A \cdot B)}$$

Using De-Morgan's law, $\overline{A + B} = \overline{A} \cdot \overline{B}$

$$Y = \overline{(\overline{A} \cdot \overline{B}) \cdot (A \cdot B)}$$

$$Y = \overline{(\overline{A} \cdot A) \cdot (\overline{B} \cdot B)}$$

$$Y = \overline{0.0} = 1$$

$\therefore$ Output is always 1.

Q27

If, $R_A < R_B$,

Now recall the formula of excess pressure inside the liquid drop,

$p_A = \frac{4T}{R_A}$ & $p_B = \frac{4T}{R_B}$,

$\Rightarrow p_A > p_B$, and we know that gases passes from high pressure to low pressure it means bubble A will become small and B will become larger.

Q28

$v = Rw$ (pure rolling)

Angular momentum about origin O, $L_O = MvR + I_O\omega$

$L_O = M(R\omega)R + \frac{1}{2}MR^2\omega$

$L_O = \frac{3}{2}MR^2\omega$

Q29

From Lens maker's formula,

$\frac{1}{\mathrm{f}}=(\mu-1)\left(\frac{1}{\mathrm{R}_1}-\frac{1}{\mathrm{R}_2}\right)$

As the radius of both the surfaces is the same,

$\frac{1}{\mathrm{f}}=(\mu-1)\left(\frac{1}{\mathrm{R}}+\frac{1}{\mathrm{R}}\right)$

$\frac{1}{\mathrm{f}}=\frac{2}{\mathrm{R}}(\mu-1)$

When one surface is plane, $R_1=R, R_2=\infty$

$\therefore \quad \frac{1}{\mathrm{f}'}=(\mu-1)\left(\frac{1}{\mathrm{R}}-\frac{1}{\infty}\right)$

$\frac{1}{\mathrm{f}'}=\frac{1}{\mathrm{R}}(\mu-1)$

$\therefore \quad \frac{\mathrm{f}'}{\mathrm{f}}=2$

$\mathrm{f}'=2\mathrm{f}$

$P=\frac{1}{f} \quad \text{and} \quad P'=\frac{1}{f'}$

$\frac{\mathrm{P}'}{\mathrm{P}}=\frac{\mathrm{f}}{\mathrm{f}'}=\frac{1}{2}$

$\mathrm{P}'=\frac{\mathrm{P}}{2}$

Q30

$F_{\text{net}} = 2F\sin\theta$

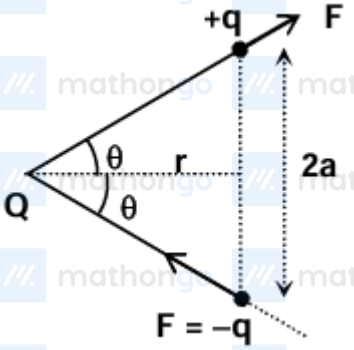
$= 2q\dfrac{kQ}{(r^2+a^2)}\dfrac{a}{\sqrt{r^2+a^2}} = \dfrac{kQp}{(r^2+a^2)^{3/2}} = \dfrac{kQp}{r^3}$

(since $r \gg a$)

$\tau = 2qE\cos\theta a = 2q\frac{kQ}{(r^2+a^2)}\frac{r}{\sqrt{r^2+a^2}}a$

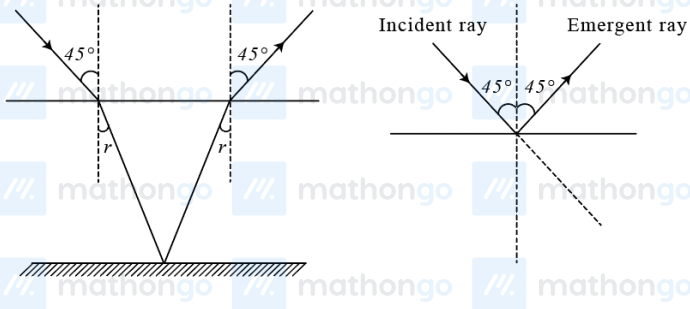
$= \frac{\mathrm{kQpr}}{(\mathrm{r}^2+\mathrm{a}^2)^{3/2}} = \frac{\mathrm{kQp}}{\mathrm{r}^2}$

(since r>>a)



Q31

The ray diagram for the given situation is shown below



Hence, emergent rays comes out at angle of 90° from incident ray.

Q32

As $\Delta\mathrm{U} = \mathrm{nR}\Delta\mathrm{T}$ For closed path

$\Delta\mathrm{T} = 0$

$\therefore \quad \Delta\mathrm{U} = 0.$

Q33

Suppose, l be the length of wire.

Hence, $l = 2\pi r \Rightarrow r = \frac{l}{2\pi}$

$\therefore$ Magnetic dipole moment,

$M = iA$

$$M = i \cdot \pi r^2 \Rightarrow = i\pi \cdot \left(\frac{l}{2\pi}\right)^2 = i\pi \cdot \frac{l^2}{4\pi^2}$$

$$\Rightarrow M = \frac{il^2}{4\pi}$$

$$l^2 = \frac{4M\pi}{i} \Rightarrow l = \sqrt{\frac{4\pi M}{i}}$$

Q34

In interference, the fringes are equally bright and equally spaced and intensity of the bright fringe is four times the intensity of each incident wave.

Resultant intensity at a point is given by

$$I = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\delta$$

where, I_1 is the intensity of the wave from source 1, I_2 is the intensity of the wave from source 2 . No two sources in nature can be coherent. So, sources are made from one source by either splitting the amplitude or the wave fronts, by means of double-slit or Fresnel's prism or Lloyd's mirror etc. Further, to get a high contrast $I_1 = I_2 = I$.

So, for constructive interference and at the central maxima $\delta = 0$,

$$I_{\max} = 2I + 2I\cos\delta = 2I(1 + \cos\delta) = 4I\cos^2\left(\frac{\delta}{2}\right) = 4I$$

So at central maxima intensity is four times the incident wave.

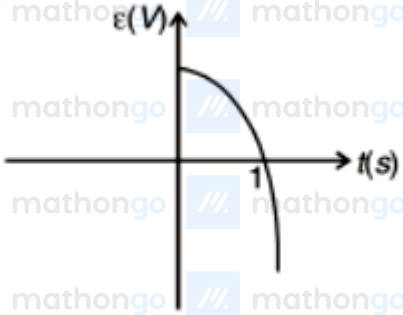
For constructive interference, the crest of one wave coincides with the crest of another wave, not the trough.

Crest and trough overlap causes destructive interference.

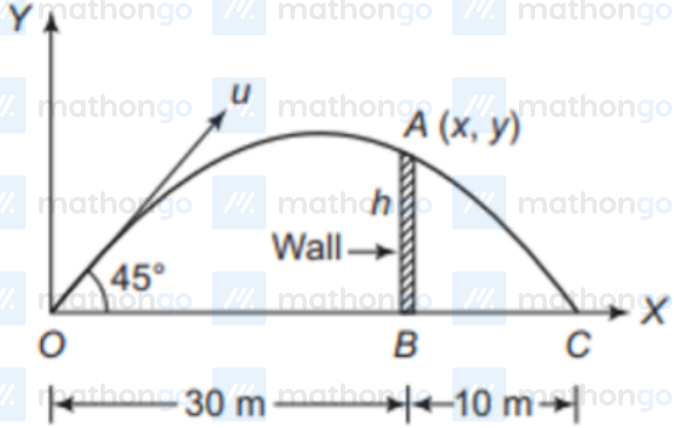
Q35

$\varepsilon = \frac{-d\phi}{dt} = -\left(3t^2 - 3\right) V$

$\varepsilon = (-3t^2 + 3)V$



Q36



Let h be the height of the wall. Given, Horizontal range $R = 30 + 10 = 40$ m and

$\theta = 45^\circ$

Now $R = \dfrac{u^2 \sin(2\theta)}{g}$

$\Rightarrow 40 = \dfrac{u^2 \sin(90^\circ)}{10} \Rightarrow u = \sqrt{400}$

$= 20 \text{ ms}^{-1}$

Let the coordinates of the top A of the wall be (x, y). Then

$x = (u\cos\theta)t \ldots$ (i)

and $y = (u\sin\theta)t - \frac{1}{2}gt^2 \ldots$ (ii)

where $x = 30$ m and $y = h$. From Eq. (i)

$t = \frac{x}{u\cos\theta} = \frac{30}{20\cos 45^\circ} = \frac{3}{\sqrt{2}}$ s

From Eq (ii),

$$h = (20\sin 45^\circ) \times \frac{3}{\sqrt{2}} - \frac{1}{2} \times 10 \times \left(\frac{3}{\sqrt{2}}\right)^2$$

$= 30 - 22.5 = 7.5$ m

Q37

To just complete the loop, the speed at the lowest point must be $v = \sqrt{5gR}$.

where $R =$ Radius of the loop.

Now for the motion from A to B, applying conservation of mechanical energy

Loss in gravitational PE =Gain in KE

$\Rightarrow mgh = \frac{1}{2}\text{mv}^2$

$\Rightarrow mgh = \frac{1}{2}\text{ m}(5gR)$

$\Rightarrow h = \frac{5}{2}R$

$\Rightarrow R = \frac{2h}{5} = \frac{2\times 5}{5} = 2$ cm.

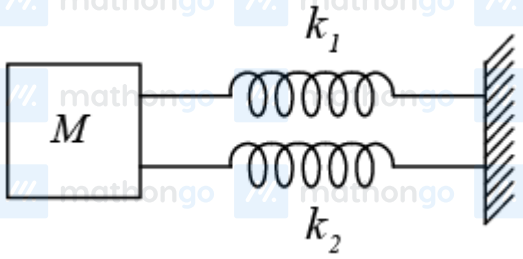
Q38

$T = 2\pi\sqrt{\frac{m}{k_1+k_2}} = 2\pi\sqrt{\frac{10}{360}} = \frac{\pi}{3}s$

The maximum velocity is always at equilibrium position since at any other point there will be a restoring force. Attempting to slow the mass. $\therefore v_{\max} = \frac{\text{impulse}}{\text{mass}} = \frac{50}{10} = 5\ \text{m/s}$

$\Rightarrow \omega = \frac{2\pi}{T} = 6\text{rad/s}$

$\Rightarrow A = \text{amplitude} = \frac{v_{\max}}{\omega} = \frac{5}{6} = \text{K}$



Q39

Average power dissipated.

$P_{\text{avg}} = \frac{v_{\text{rms}}^2 R}{z^2}$

Here, $Z = \text{impedence} = \sqrt{X_L^2 + R^2}$

where, $X_L = \text{inductive reactance} = L\omega$

So impedence, $z = \sqrt{X_L^2 + R^2}$

$= \sqrt{1^2 + 3^2}$

(Here given, $X_L = 1\Omega$ and $R = 3\Omega$)

So,

$z = \sqrt{10}$

Given ; $V_{\text{rms}} = 10$ V so,

$$P_{\text{avg}} = \frac{V_{\text{rms}}^2 R}{z^2} = \frac{100 \times 3}{10}$$
$$= 30 \text{ W}$$

Q40

$$\left[\text{MLT}^{-2}\right] = \left[\text{L}^{2a}\right] \times \left[\text{L}^{b}\text{T}^{-b}\right]\left[\text{M}^{c}\text{L}^{-3c}\right]$$
$$= \left[\text{M}^{c}\text{L}^{2a+b-3c}\text{T}^{-b}\right]$$

Comparing powers of M, L and T, on both sides, we get

$\text{c} = 1, 2\text{a} + \text{b} - 3\text{c} = 1, -\text{b} = -2$ or $\text{b} = 2$

Also, $2\text{a} + 2 - 3(1) = 1 \Rightarrow 2\text{a} = 2$ or $\text{a} = 1$

$\therefore$ This is 1,2,1

Q41

From equation of continuity

$A_1V_1 = A_2V_2 \Rightarrow V_2 = 2V_1$ .....(1)

From Bernoulli's theorem

$$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2$$
$$\Rightarrow \frac{1}{2}\rho\left(V_2^2 - V_1^2\right) = P_1 - P_2$$

$\Rightarrow \frac{1}{2} \times 700 \times 3V_1^2 = 4200$

$V_1 = 2\ \text{m/s}$

Volume flow rate $A_1V_1 = 1.2 \times 10^{-3} \times 2\ \text{m}^3/\text{s}$

$= 24 \times 10^{-4}\ \text{m}^3/\text{s}$

Q42

Let $\phi_1 = 4\text{eV}$, then $\phi_2 = 2\text{eV}$

$(E - \phi)$ represent kinetic energy of most energetic electron.

$\text{E} - \phi_2 = 2\,(\text{E} - \phi_1)$

$\Rightarrow \text{E} = 6\text{eV}$

Q43

Given, mass, $m = (0.3 \pm 0.003)\text{g}$

Radius, $r = (0.5 \pm 0.005)\text{mm}$

Length, $l = (6 \pm 0.06)\text{cm}$

Density of cylinder, $\rho = \frac{\text{Mass}}{\text{Volume}} = \frac{m}{\pi r^2 l}$

Fraction error in ρ,

$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + \frac{2\Delta r}{r} + \frac{\Delta l}{l}$

Percentage error in ρ,

$\frac{\Delta\rho}{\rho} \times 100 = \frac{\Delta m}{m} \times 100 + \frac{2\Delta r}{r} \times 100 + \frac{\Delta l}{l} \times 100$

$= \frac{0.003}{0.3} \times 100 + 2 \times \frac{0.005}{0.5} \times 100 + \frac{0.06}{6} \times 100$

$= 1 + 2(1) + 1 = 4\%$

Q44

For a gas having n moles of molecules with each f degrees of freedom at temperature T K, internal energy is

$U = \frac{1}{2}nfRT$

$\therefore$ Total internal energy is

$U = n_1\frac{f_1}{2}\,RT + n_2\frac{f_2}{2}\,RT$

$= 2 \times \frac{5}{2}\,RT + 4 \times \frac{3}{2}RT$

$= 5RT + 6RT$

$U = 11RT$

Q45

$x = 3t^2 \Rightarrow v = \frac{dx}{dt} = 6t \ \& \ a = \frac{dv}{dt} = 6$

$P = F \cdot v = mav = 2 \times 6 \times 6t$

$P = 72 \times 4 = 288 \text{ W}$

Hence option (1)

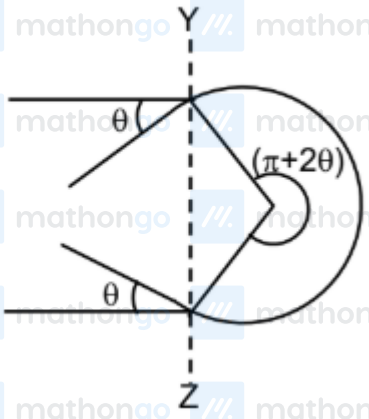
Q46

$\omega = \frac{qB}{m} = \alpha B$

Clearly,

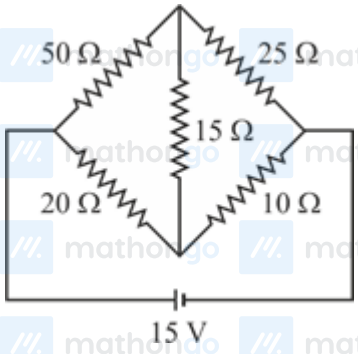
$t = \frac{\pi + 2 \times \pi/3}{\omega}$

$= \frac{5\pi}{3\alpha \text{ B}}$



Q47

Given, arrangement is a balanced Wheatstone bridge clearly, $\frac{50}{20}=\frac{25}{10}$



So, 15Ω resistance can be removed so equivalent resistance is

$R_{\text{eq}}=\frac{75\times30}{75+30}=\frac{150}{7}$

So, current, $I=\frac{15}{150}\times7=0.7\text{ A}$

Q48

Let t be the thickness of the dielectric slab and K is the dielectric constant.

So, the increase in the distance of separation between the plates due to dielectric is given as

$x=t-\frac{t}{K}$

$=t\left(1-\frac{1}{k}\right)$

Given, $x=3.5\times10^{-3}\text{ m}, t=4\times10^{-3}\text{ m}$

Substituting the given values in the above equation, we get

$1-\frac{1}{k}=\frac{x}{t}=\frac{3.5\times10^{-3}}{4\times10^{-3}}=\frac{3.5}{4}$

or

$\frac{1}{k}=1-\frac{3.5}{4}=\frac{0.5}{4}$

or

$k=8$

Q49

$\text{Mg}-\text{T}-6\pi\eta\text{r}_1\text{v}=0$

$\text{mg}+\text{T}-6\pi\eta\text{r}_2\text{v}=0$

$\frac{\frac{4}{3}\pi\left(\text{r}_1^3+\text{r}_2^2\right)\times\rho\text{g}}{6\pi\eta\left(\text{r}_1+\text{r}_2\right)}=\text{v}$

$v = \frac{2}{9}\left(r_1^2 - r_1 r_2 + r_2^2\right)\frac{\rho g}{\eta}$

$T = Mg - 6\pi\eta r_1 \times \frac{2}{9}\left(r_1^2 - r_1 r_2 + r_2^2\right)\frac{\rho g}{\eta}$

$= \frac{4}{3}\pi r_1^3 \times \rho g - \frac{4\pi}{3}\rho g\left[r_1^3 - r_1^2 r_2 + r_2^2 r_1\right]$

$= \frac{4}{3}\pi g r\left[r_1^2 r_2 - r_2^2 r_1\right]$

$= \frac{4}{3}\pi r g r_1^2\left[r_2 - \frac{r_2^2}{r_1}\right]$

$\frac{dT}{dr_2} = 0 \Rightarrow \frac{4}{3}\pi g r_1^2\left[1 - \frac{2r_2}{r_1}\right] = 0$

$r_1 = 2r_2$

$\frac{M}{m} = 8$

Q50

According to question,

$B_1 = \frac{\mu_0 I R^2}{2(R^2+r^2)^{3/2}}$

Here, $r = R\sqrt{3}$

$\therefore \quad B_1 = \frac{\mu_0 I R^2}{2\left[R^2 + (R\sqrt{3})^2\right]^{3/2}} = \frac{\mu_0 I R^2}{2[4R^2]^{3/2}} = \frac{\mu_0 I R^2}{16R^3}$

$B_1 = \frac{\mu_0 I}{16R} \quad \ldots(i)$

and $B_2 = \frac{\mu_0 I}{2R}$ ...(ii)

[magnetic field at centre]

Now, dividing Eq. (i) by Eq. (ii), we get

$\therefore \quad \frac{B_1}{B_2} = \frac{\mu_0 I/16R}{\mu_0 I/2R} = \frac{1}{8}$

Q51

Given,

density $(d) = 1.12 \text{ g mL}^{-1}$

Mass of solute $(w) = 120 \text{ g}$

Molar mass of solute $(M) = 60$

Mass of solvent $(w) = 1000 \text{ g} = 1000 \text{ mL}$

$\therefore$ Total mass $= 1000 + 120 = 1120 \text{ g}$

$\because \quad d = \dfrac{\text{Mass}}{\text{Volume } (V)}$

$\therefore$ Total volume $(V) = \dfrac{1120}{1.12} = 1000 \text{ mL}$

$\because$ Molarity $(c) = \dfrac{w}{M} \times \dfrac{1000}{V}$

$\because$ Molarity $(c) = \dfrac{w}{m} \times \dfrac{1000}{1000} = \dfrac{120}{60} = 2.0 \text{ m}$

Q52

Zinc rod dipped in blue copper sulphate solution is oxidised to Zn^{2+} and Cu^{2+} are reduced to Cu and get deposited on zinc rod.

Q53

$[Fe(CN)_6]^{3-}$ has Fe^{3+} central ion $\left(d^5\right)$

Electronic configuration (SFL)

$t_{2g}{}^{2,2,1} e_g{}^{0,0}$

$n = 1$

Magnetic moment:

$\mu = \sqrt{n(n+2)} \text{ BM}$

$= \sqrt{1(1+2)}$

$= \sqrt{3}$

$= 1.73\ \text{BM}$

$\left[\text{Fe}\left(\text{H}_2\text{O}\right)_6\right]^{3+}$: has d^5 electrons.

Electronic configuration (WFL)

$\text{t}_{2\text{g}}{}^{1,1,1}\text{e}_{\text{g}}^{1,1}$

$\text{n} = 5$

$\mu = \sqrt{5(5+2)} = \sqrt{35}$

$= 5.92\ \text{B.M.}$

$[\text{Fe}(\text{CN})_6]^{4-}$ has d^6 electrons.

Electronic configuration (SFL)

$\text{t}_{2\text{g}}^{2,2,2}\text{e}_{\text{g}}^{0,0}$

$\text{n} = 0$

$\mu = 0\ \text{B.M.}$

$\left[\text{Fe}\left(\text{H}_2\text{O}\right)_6\right]^{2+}$ has d^6 electron

Electronic configuration: (WFL)

$\text{t}_{2\text{g}}^{2,1,1}\text{e}_{\text{g}}^{1,1}$

$\text{n} = 4$

$\mu = \sqrt{4(4+2)} = 4.90\ \text{B.M.}$

Q54

$\text{X} = 4(\text{I}, \text{II}, \text{ III, VI})$

$\text{y} = 5(\text{I}, \text{II}, \text{III}, \text{IV}, \text{ VI})$

$\text{Z} = 1(\text{ V})$

Q55

(I) <u>As temperature Rises</u>

K_a will increase K_b will also increase

since $E_a < E_b$

$K_a >> K_b$

(II) <u>At lower temperature</u>

K_a will fall

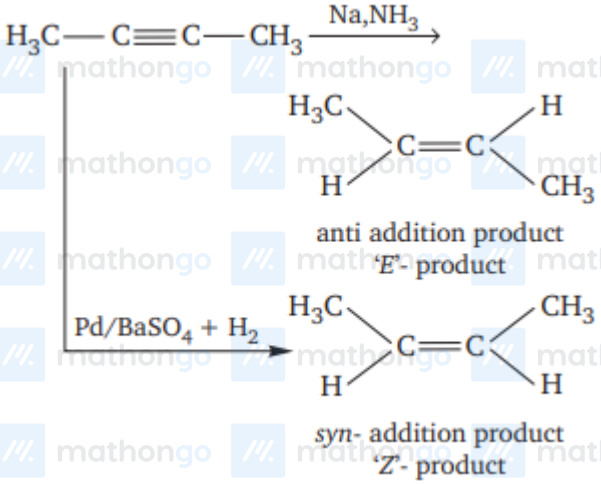
K_b will fall

But as $E_a < E_b$

$K'_a > K'_b$

(II) As temperature rises very high K_a and K_b will try to close each other as they are exponential functions of temperature

Q56



Hence, reagent X and Y are respectively Na, NH_3 and $Pd/BaSO_4 + H_2$.

Q57

$\overset{0}{Cl_2}(g) + 2OH^-(aq) \rightarrow \overset{+1}{Cl^-}(aq) + \overset{-1}{Cl^-}(aq) + H_2O(l)$

Chlorine is simultaneously reduced and oxidised.

Q58

In the saturated solution of

$Zr_3(PO_4)_4 + aq \rightleftharpoons \underset{3S\text{ molar}}{3\,Zr^{4+}} + \underset{4S\text{ molar}}{4\,PO_4^{3-}}$

$K_{sp} = \left[Zr^{4+}\right]^3\left[PO_4^{3-}\right]^4 = (3S)^3(4S)^4$

$= 27 \times 256 \times s^7 = 6912\ S^7$

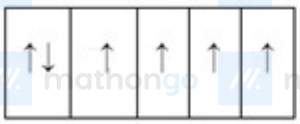
$S = \left(\frac{K_{sp}}{6912}\right)^{1/7}$

Q59

Outer electronic configuration of Mn is $3d^5 4s^2$ which means it can show +7 oxidation state also (correct)

Zinc does not form coloured ions as it has completely filled $3d^{10}4s^2$ configuration.

In $\left[CoF_6\right]^{3-}$, Co^{3+} is a d^6 system. Fluoride is a weak field ligand and hence it can not cause pairing of electrons.



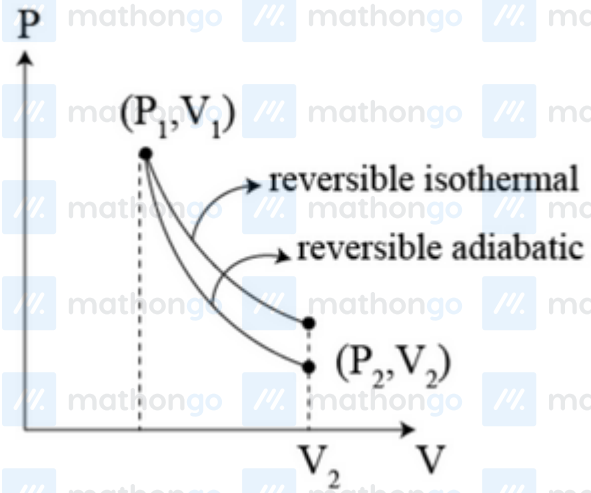
Co^{3+}; Paramagnetic.

Sc can show a maximum of +3 oxidation state as it has an outer electronic configuration of $3d^1 4s^2$.

Zn exhibits only +2 oxidation state as this oxidation state is the most stable one for it.

Hence (ii), (iii), (iv) are incorrect while (i), (v) are correct.

Q60



Area under curve in reversible isothermal is more. So, more work will be done by gas.

$T_1 = T_2$

$\Delta U = nC_V\Delta T = 0$

In reversible adiabatic expansion, $T_2 < T_1$

So $\Delta T = -ve, \Delta U = -ve$

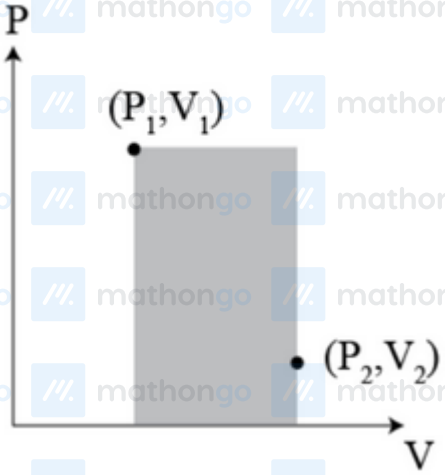
In free expansion, $P_{ext} = 0$

So $W = 0$

If carried out isothermally $(\Delta U = 0)$

$q = 0$ (adiabatic); from I law

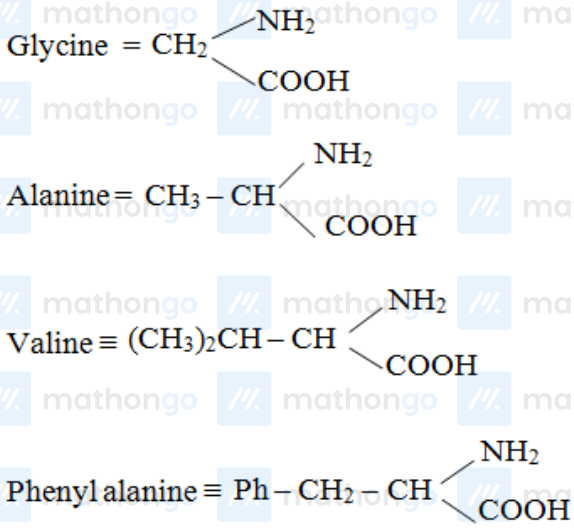
If carried out adiabatically $(q = 0)$



$\Delta U = 0$ (isothermal); From I law

During irreversible compression, maximum work is done on the gas (corresponding to shaded area).

Q61



Hence, number of possible sequences (primary structures) with $-NH_2$ group attached to a chiral center is 4.

Since -COOH group is attached to alanine, one terminal of the tetrapeptide contains alanine. Thus, its position is fixed.

Glycine is achiral whereas valine and phenylalanine are chiral. Thus, $-NH_2$

group is attached to either valine or phenylalanine.

Thus following are the four possible combinations of the tetrapeptide.

$H_2N-Val-Gly-Phe-Ala-COOH$
$H_2N-Val-Phe-Gly-Ala-COOH$
$H_2N-Phe-Gly-Val-Ala-COOH$
$H_2N-Phe-Val-Gly-Ala-COOH$

Q62

$$12.75=\left|E_0-\frac{E_0}{n^2}\right|=\left|-13.6-\frac{(-13.6)}{n_1^2}\right|$$

$\Rightarrow n=4$

$$\text{no. of lines }=\frac{n(n-1)}{2}=6$$

Q63

Assertion is false but reason is true.

More is the electron affinity, greater is the Oxidising character.

Reducing agent itself gets oxidised so its reducing power will depend on its ability to get quickly oxidised, which is expressed in its oxidation potential.

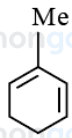
Q64

Information (1) indicates that compound has a carbonyl $\left(\begin{array}{c}\text{O}\\ \|\\ -\text{C}-\end{array}\right)$ group.

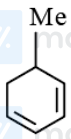
Information (2) indicates that compound has a methyl ketone $\left(\begin{array}{c}\text{O}\\ \|\\ \text{CH}_3-\text{C}-\end{array}\right)$ group.

Information (3) indicates that it is 3° amine and not 1° amine so answer is (B) which gives 2, 4-DNP test and iodoform test.

Q65

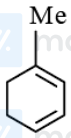


2-Methylcyclohexa-1,3-diene ,



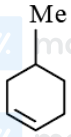
5-Methylcyclohexa-1,3-diene

3-Methylcyclohexa-1,4-diene ,



1-Methylcyclohexa-1,3-diene

1-Methylcyclohexa-1,4-diene ,



4-Methylenecyclohex-1-ene

2-Methylenecyclohex-1-ene

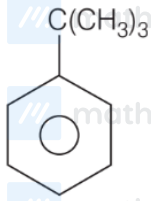
Q66

During chlorination of alkane, if excess of alkane is treated with $Cl_2\,(g)$ in presence of light or heat, chance of mono–chlorination predominates.

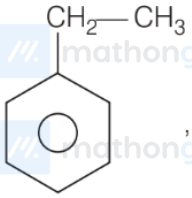
$$C_2H_6\,(\text{excess}) + Cl_2 \xrightarrow{\text{UV light}} CH_3\,CH_2\,Cl + HCl$$

Q67

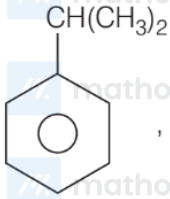
Key Idea More be the H-atoms associated (bonded) with the C-atom, which is bonded with the benzene ring, more will be the number of 'no bond resonance' structures shown by them.

In structure (a) 

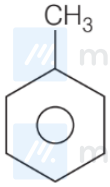
, the C-atom associated with the ring has no H-atom.

In structure (b) 

, the C-atom bonded with the ring has 2 H-atoms.

In structure (c) 

, the C-atom bonded with the ring has one H-atom.

In structure (d) 

, the C-atom bonded with the ring has 3H-atoms.

Hence, option (d) is the correct answer.

Q68

(a)→(ii) Sand Meyer reaction

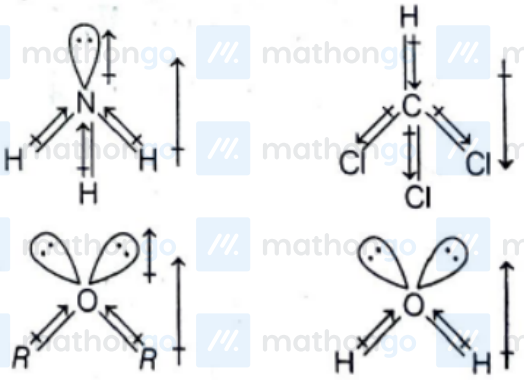
(b)→(iv) Gatterman reaction

(c)→(i) Wurtz reaction

(d)→(iii) Fittig reaction

Q69

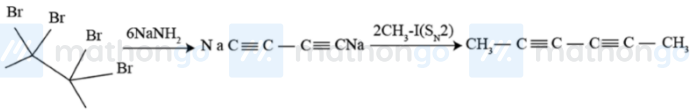
Dipole moments cancel out reach other in CCl_4 and CO_2 resulting in net dipole moment as zero because these are symmetrical structures.



Q70

CO_2 is an acidic oxide, CO is neutral and BeO is an amphoteric oxide.

Q71



So $x + y = 6 + 2 = 8$.

Q72

Let the mass of CuO = w g

For one mole of Cu_2O : mass of Cu = 127 g; gram molecular mass = 143 g

For one mole of CuO : mass of Cu = 63.5 g; gram molecular mass = 79.5 g

Thus, for w g CuO, mass of $Cu = \frac{63.5w}{79.5}$ g

And, for $(0.5 - w)$ g Cu_2O, mass of $Cu = \frac{127(0.5-w)}{143}$ g

Now, $\frac{63.5w}{79.5} + \frac{127(0.5-w)}{143} = 0.425$

$w = 0.21$ g

K=0.21g, 10K=2.1g

Q73

$Cl_2(g) \rightarrow 2Cl(g)$; $\Delta H_1 = 242.3 kJ/mol$

$I_2(g) \rightarrow 21(g)$; $\Delta H_2 = 151 kJ/mol$

$ICI(g) \rightarrow I(g) + Cl(g); \Delta H_3 = 211.3 kJ/mol$

$I_2(s) \rightarrow I_2(g); \Delta H_4 = 62.8 kJ/mol$

required equation:

$\frac{1}{2}I_2\left(g\right) + \frac{1}{2}Cl_2\left(g\right) \rightarrow ICl\left(g\right); \Delta H = ?$

$\Delta H = \frac{62.8+151+242.3}{2} - 211.3$

$= 16.75\ kJ/mol$

Q74

Total 8 f-Block elements in 4f-series have odd electrons in f-orbitals in their ground state configuration.

$_{58}Ce, _{59}Pr, _{61}Pm, _{63}Eu, _{64}Gd, _{65}\ Tb, _{67}Ho, _{69}Tm$

List of elements with odd-numbered f-electrons:

1. Cerium $(Ce) \rightarrow 4f^1$

2. Praseodymium $(Pr) \rightarrow 4f^3$

3. Promethium $(\mathrm{Pm}) \rightarrow 4\mathrm{f}^{5}$

4. Europium $(Eu) \rightarrow 4f^{7}$

5. Gadolinium $(\mathrm{Gd}) \rightarrow 4\mathrm{f}^{7}$

6. Terbium $(\mathrm{Tb}) \rightarrow 4\mathrm{f}^{9}$

7. Holmium $(\mathrm{Ho}) \rightarrow 4\mathrm{f}^{11}$

8. Thulium $(\mathrm{Tm}) \rightarrow 4\mathrm{f}^{13}$

Q75

The total number of isomers for the complex compound $\left[\mathrm{Cu}^{\mathrm{II}}(\mathrm{NH}_3)_4\right]\left[\mathrm{Pt}^{\mathrm{II}}\mathrm{Cl}_4\right]$ is four. These four isomers are

$\left[\mathrm{Cu}(\mathrm{NH}_3)_3\mathrm{Cl}\right]\left[\mathrm{Pt}\left(\mathrm{NH}_3\right)\mathrm{Cl}_3\right]$

$\left[\mathrm{Cu}\left(\mathrm{NH}_3\right)\mathrm{Cl}_3\right]\left[\mathrm{Pt}(\mathrm{NH}_3)_3\mathrm{Cl}\right]$

$\left[\mathrm{CuCl}_4\right]\left[\mathrm{Pt}(\mathrm{NH}_3)_4\right]$

and $\left[\mathrm{Cu}(\mathrm{NH}_3)_4\right]\left[\mathrm{PtCl}_4\right]$

The isomer $\left[\mathrm{Cu}(\mathrm{NH}_3)_2\mathrm{Cl}_2\right]\left[\mathrm{Pt}(\mathrm{NH}_3)_2\mathrm{Cl}_2\right]$ does not exist due to both parts being neutral.